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TASK I - PHASE I

PILOT STUDY OF CANCER MORTALITY NEAR AN ARSENICAL PESTICIDE PLANT IN BALTIMORE

MAY 1976

FINAL REPORT

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Toxic Substances
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16. ABSTRACT

The population of the area surrounding a chemical plant which produced arsenical pesticides had possibly been exposed to arsenic in the environment. In order to determine whether there had been a carcinogenic effect from the exposure, a pilot study of the cancer mortality of the four census tracts for which at least half of the tract area lay within three quarters of a mile of the plant was conducted for the years 1970-1972. The rates were compared to those of the other 23 tracts in the city which were similar to the index tracts for five variables measuring age, race, and sex distribution and socioeconomic characteristics.

The results indicate that lung cancer mortality in males is significantly higher for the tract in which the plant is located as compared to control areas. Two of the other three tracts also had higher lung cancer mortality than controls but the difference was not significant and the values were lower than those of the tract in which the plant was located. The four-fold excess in lung cancer deaths did not appear to be related to occupational exposure.

Total cancers in females and those at other sites in males were too few in number to place any reliance on death rates. The high mortality from oral cancer, especially in females, deserve further study.

17. KEY WORDS AND DOCUMENT ANALYSIS

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Mortality analysis Lung Cancer Insecticide/arsenic exposure Air pollution Analysis by census tracts	Arsenic Insecticides Cancer Census tracts PRICES SUBJECT TO CHANGE	

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PILOT STUDY OF CANCER MORTALITY NEAR AN ARSENICAL PESTICIDE PLANT IN BALTIMORE

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The measurement of long-term effects from low-level exposure to carcinogens in air has been a difficult problem because of the presence of multiple agents, the changing population bases exposed, and the involvement of personal risk factors during the long latent period before cancer is manifest. Possibly because of these confounding variables, the studies relating levels of air pollution to localized cancer mortality by census tracts have been few in number and frequently unrewarding. Winkelstein and coworkers (1) in Buffalo and Zeidberg, Horton and Landau (2) in Nashville found no correlation between the level of pollution and the risk of lung cancer. However, Menck, Casagrande and Henderson (3) did find higher rates in contaminated areas of Los Angeles which they associated with the presence of benzo(a)pyrene in air.

Studies aimed specifically at determining the health effects of arsenic in the general environment, especially around smelters, are also limited. Milham and Strong (4) have demonstrated excessive levels of arsenic in urine and hair of children exposed to the emissions from a copper smelter but no detrimental health effects were noted. Blot and Fraumeni (5) have reported excess lung cancer mortality for both males and females in counties with copper, lead or zinc smelting industries. The latter data agree with the reported risks of lung cancer in populations occupationally exposed to arsenic (6, 7). A direct association of cancer and environmental arsenic has not been demonstrated.

The current pilot project tests the feasibility of determining the carcinogenic effects of arsenic by examining the mortality of populations living near an insecticide-producing industry. Cancer death rates in populations from census tracts near the plant are compared to all the tracts in the city which match on several variables. The advantage of using this matching study design is that data from other projects with similar designs might be combined despite differences in the characteristics of the populations exposed to the arsenic in various cities.

Background

For many years a chemical plant in south Baltimore produced arsenicals as well as other chemicals for agricultural use. Arsenic acid was manufactured in the early 1900's but this operation was discontinued over 20 years ago and the plant reconstructed in 1952. The insecticide portion of the plant produced several arsenates but these chemical procedures have also been terminated. Lead arsenate production was discontinued in 1967, calcium arsenate in 1973 and sodium arsenate in 1974. The plant continues to package many of these arsenicals for distribution. The insecticide plant has also produced chlorinated hydrocarbons and organic phosphates.

The area around the plant is heavily industrialized. Adjacent to the chemical plant was a Gas and Electric Company operation. Rubber production also took place nearby. The significance of these possible sources of contamination must be investigated.

Methods

Index census tracts with possible environmental exposure to arsenic were defined empirically as those tracts for which at least fifty percent of the area was included within a 3/4 mile radius of the plant (Figure 1). This distance was selected because any smaller radii would have included only the single tract in which the plant was located and larger radii would have included tracts across the river in an area with heavy industry and few private dwellings within one mile of the chemical plant. Four census tracts which fell within these boundaries are 2303, 2302, 2404 and 2301. The populations of the first three tracts were similar in demographic and socio-economic characteristics (See tables 1 and 2, Figure 2). The 1970 census data indicated that the residents were an older, stable, white population with median incomes from $8400-9200 per annum. The population of tract 2301 had a lower median income, a higher proportion of families at poverty level, and a higher percentage of blacks than the other three tracts. Separate matching control tracts were selected for the first three index tracts, Match I, and for 2301, Match II. All census tracts in Baltimore City which matched the index tracts on six variables were chosen as controls. The variables and the range of differences which were acceptable for matching were:

Age distribution	$\pm$ 10% for each age group
Race	$\mp$ 15% expressed as % black
Sex	$\mp$ 5% expressed as % male
Median income	$\pm$ $1000
% below poverty level	$\pm$ 10%
% head of household over 65 years	$\pm$ 20%

Several of the matching tracts were adjacent to the index tracts and have been analyzed separately in the event that the population of those tracts may also have had minimal exposure. One possible control tract was dropped because of an excess of white females in the older age group resulting from the presence of a nursing home in that tract.

For some of the analyses, the control tracts have been subdivided into groups according to geographic location since the populations in various areas of the city differ in their exposure to heavy industry or in mobility. The southern tracts have several areas of industrialization. The central area includes inner city tracts with both problems of industrial exposure and mobility. The northern tracts are found in primarily residential areas. No Match II controls were found in the south.

All death certificates in Baltimore City for the three years 1970-1972 have been examined for cancer listed anywhere among the causes of death. All cancers have been classified according to the 1965 ISCD code. If no cancer code appeared on the certificate, the cancer was classified by the staff; otherwise the coding as recorded by city vital statistics personnel was accepted.

The occupation and place of employment as recorded on the certificate were listed in order to detect deaths of chemical plant workers. Such information might also identify other dangerous occupations.

The census tract codes noted on the certificates were used for classifying residence. The validity of the codes was checked by selecting a seven and ten percent systematic sample of the cancer deaths in the years 1971 and 1972 respectively. The census tracts incorrectly coded were eight percent in the first sample and fifteen percent in the second sample. To avoid erroneously adding cancer deaths to index tract mortality from misclassification, the residence was listed for all cancer deaths in the index tracts and recoded correctly. This procedure allowed elimination of deaths from the index tracts but no additions from misclassifications in other tracts, thus providing a minimum estimate of cancer mortality in these tracts.

Results

The crude cancer death rates for selected sites and total cancers in each sex are presented in tables 3 and 4 for the combined tracts. The data suggest that the risk of lung cancer in males is 1.4 times higher in the index as compared to the non-adjacent control tracts. The risk in the mixed racial index tract is even higher in comparison to its matched controls. The lung cancer mortality for females is not higher in the index as compared to the adjacent control tracts.

The rates in these tables include cancer as listed anywhere on the death certificate but the relationship is not changed if only underlying cause is used. The inclusion of lung cancers classified as secondary or unspecified does not change these observations.

Although the tracts have been matched by age, race and sex so that crude rates should be comparable in the populations, the sex-specific rates of the white population have been adjusted for age in tables 5 and 6 in order to determine whether this variable had any influence on lung cancer mortality. The 1970 Baltimore City population has been used as the standard for a direct adjustment. In these tables, the matching tracts have been subdivided by their location in northern, central and southern geographic areas in order to detect any possible internal differences in controls. None of these adjustments have altered the conclusions based on the crude rates although the magnitude of the excess risk of lung cancer mortality varies depending on which geographic area control is used.

Race-specific rates adjusted for age and sex in tables 7 and 8 indicate that the blacks in the one index tract 2301 may not have a higher rate than inner city populations after adjustment although the white population still has a higher rate. The number of deaths in blacks is small.

The crude death rates for individual index tracts are presented in tables 9 and 10 . The data in table 9 indicate that the differences between lung cancer death rates in white males in tract 2303 where the plant is located and the northern and southern controls are significant for both comparisons with probabilities of .0002 and .0003 respectively (8, 9). The

relative risk weighted by age of lung cancer deaths in males in this tract is 3.3 and 4.0 times higher than in the southern and northern controls respectively. Although the relative risk of lung cancer is higher in males in tracts 2301 and 2302, suggesting a possible gradient in death rates for this disease, the differences between index and control rates are significant for 2301 only. The death rates for several other cancer sites (oral, stomach, pancreas, and prostate) appear high in one or more of the census tracts near the plant but the numbers of deaths are so small that no importance can be attached to the observation.

It was suspected that employees of the plant who lived in the local area might be contributing to the excess mortality in the index tracts. An examination of the industries of employment recorded on the death certificates revealed one man with lung cancer who worked in a chemical plant. Employment records from the insecticide plant were checked to determine whether any of the cancer deaths had occurred in workers. The same case of lung cancer noted above and a prostatic cancer death were matched to plant employees. Removing the case of lung cancer reduces the rate for tract 2303 from 395 to 355 per 100,000 white males. The significant difference in lung cancer deaths in tract 2303 as compared to controls remains.

The occupation as listed on the death certificate indicated no other work exposure which might explain the excess deaths. It is recognized how inaccurate such data are in determining an individual's occupational history.

Out of the 96 cancer deaths in the index tracts 28 had no reported occupation and an additional 19 were listed as housewives. Among the remaining 49 cancers, 5 occurred in laborers, 4 in machinists, 4 in truck drivers, 3 in salesmen with all other occupations being noted less frequently. The industries recorded on the death certificates also did not indicate any remarkable excesses. Fifty cancer deaths had no industry noted and the 19 housewives are included here. The only industry noted three times was "shipbuilding and repair" which may relate to the presence of a large shipyard in the south-eastern corner of the city.

The data were suggestive of a gradient in lung cancer mortality in a northerly direction with intermediate rates in index tracts 2302 and 2301 as compared to the tract with the chemical plant and lower rates in the adjacent control tracts. A spot map of the residences of individuals dying of lung and other cancers during the three year period 1970-72 are noted in Figure 3. These data also suggest a clustering of lung cancer deaths. An examination of the direction of wind currents in Baltimore indicate the winds with highest velocity flow from the west and northwest 32 percent of the time in the winter. These winds should dump most of the contamination into relatively unpopulated areas. The south and southwest winds which could be carrying contamination into the northern tracts occur 22 percent of the time in the summer and only 13 percent of the time in the winter and have a lower velocity. Figure 4 demonstrates wind roses for Dundalk Terminal four decades ago; they are not believed to have changed significantly since that time.

Discussion

A matched control design similar to that utilized in the present pilot study might be effective in determining the cancer risks associated with environmental pollution. Frequently the population exposed to any single source of pollution may be too small and the cancers too infrequent to be sure of significant results. By using the matched census tract design to study several exposure sites even in different cities, one may be able to add the data or at least find consistent results which will support an association between a specific contaminant and a specific cancer even though there are basic differences in the characteristics of the populations exposed at each of the various sites.

In the current pilot project there is a significant increase in lung cancer mortality in males in a census tract adjoining an industrialized area containing an arsenical-producing chemical plant. The data also suggest a decreasing northerly gradient in rates for this cancer which could be related to distance from the plant. Although cancer rates for several other sites may appear high, the numbers are too small to attach any weight to the observation.

The lack of any excess lung cancer mortality in females raises questions about whether the differences should be attributed to environmental or occupational exposure. An examination of plant records indicates that employment in the chemical plant cannot explain the male-female discrepancy or the excess lung cancer mortality. From death certificate data no other industrial exposure predominated in these men but this occupational information is incomplete and unreliable. It is possible, however, that environmental exposure to agents such as arsenic may require the synergistic action of cigarette smoking before lung cancers are manifest. This hypothesis would be compatible with the data on occupational lung cancer in asbestos and uranium mine workers who experienced an excess of lung cancers only in association with cigarette smoking. Exposure to arsenic in females may not produce lung cancer because of infrequent cigarette smoking in the past, although it may produce cancer at a site other than the lung. Moss (10) reported that female woolen textile workers had an excess risk of oral cancers which he attributed to arsenic exposure from sheep-dip; he did not report an excess risk of lung cancers. Thus, health effects from environmental exposure to an agent may be different depending on sex, age, and simultaneous exposure to other personal risk factors.

The data from this study are still preliminary. The information should be expanded with deaths from additional years, validation of pathology records and further information on the personal characteristics of the deceased. Sampling of soil and dust in the area to detect the presence of arsenic or other contaminants should be accomplished.

Summary

The present study was a preliminary attempt to determine the feasibility of using cancer mortality data to indicate the carcinogenic effects of possible arsenic exposure in the environment. The four census tracts for which fifty percent of the areas lay within a 3/4 mile radius of an arsenical-producing insecticide plant were matched by such demographic characteristics as age, race, sex, and socioeconomic status with all other similar tracts in Baltimore City. The matching tracts were then subdivided according to suspected differences in exposure to environmental pollution. The lung cancer mortality was higher for the combined tracts adjacent to the plant as compared to the control tracts. The lung cancer mortality for the tract in which the plant was located was three to four times higher than in controls tracts, a difference which was significant. The data also support a northerly gradient in rates with increasing distance from the plant.

The difference in lung cancer mortality which was present only in males could not be explained by employment in the insecticide plant or in other high risk occupations. It is possible that differences in smoking habits in previous time periods might explain the discrepancy in rates by sex. Additional deaths as well as further information on occupation and personal habits are needed to validate the findings.

Figure 1

Map of area surrounding chemical plant

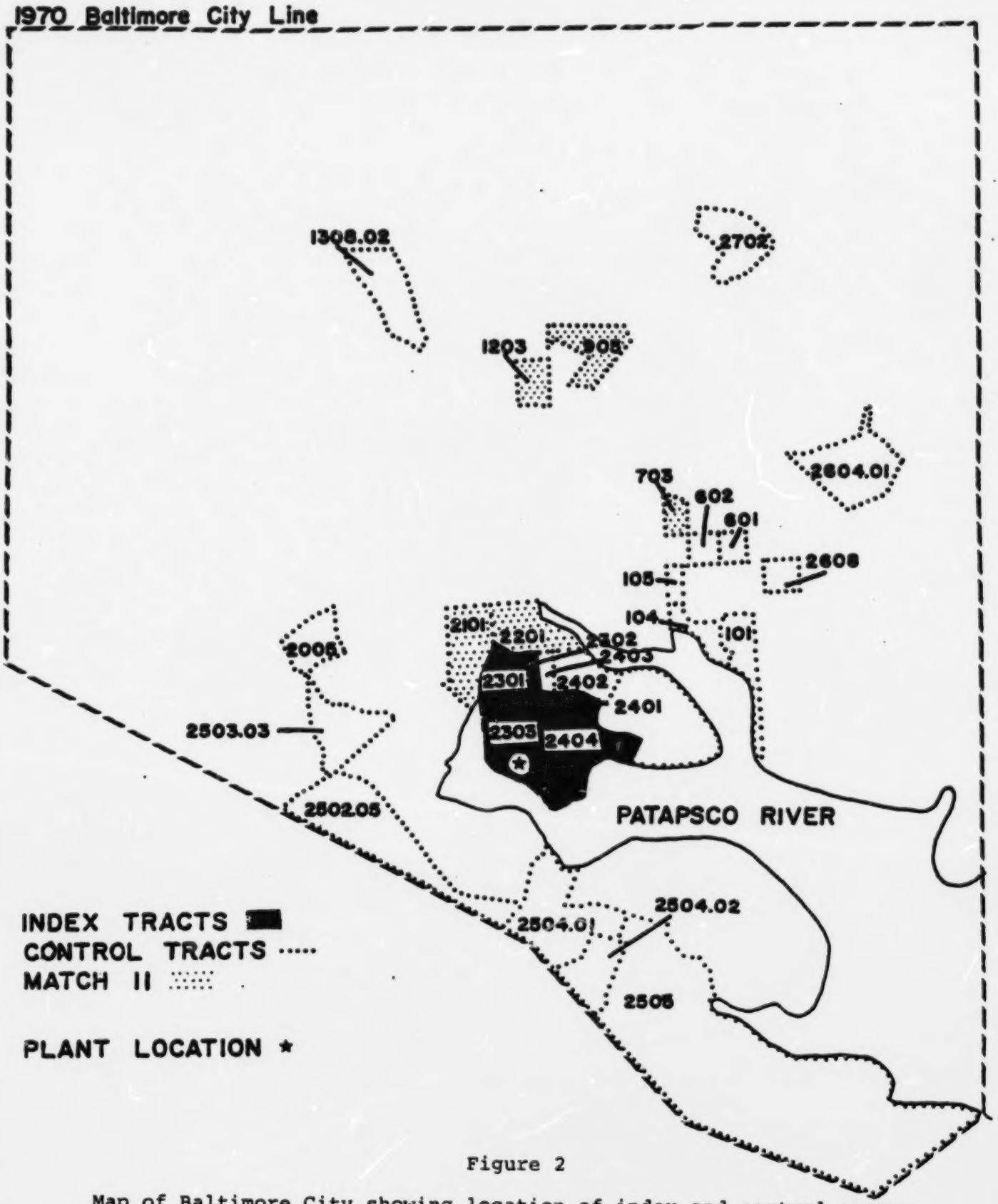


Figure 2

Map of Baltimore City showing location of index and control census tracts.

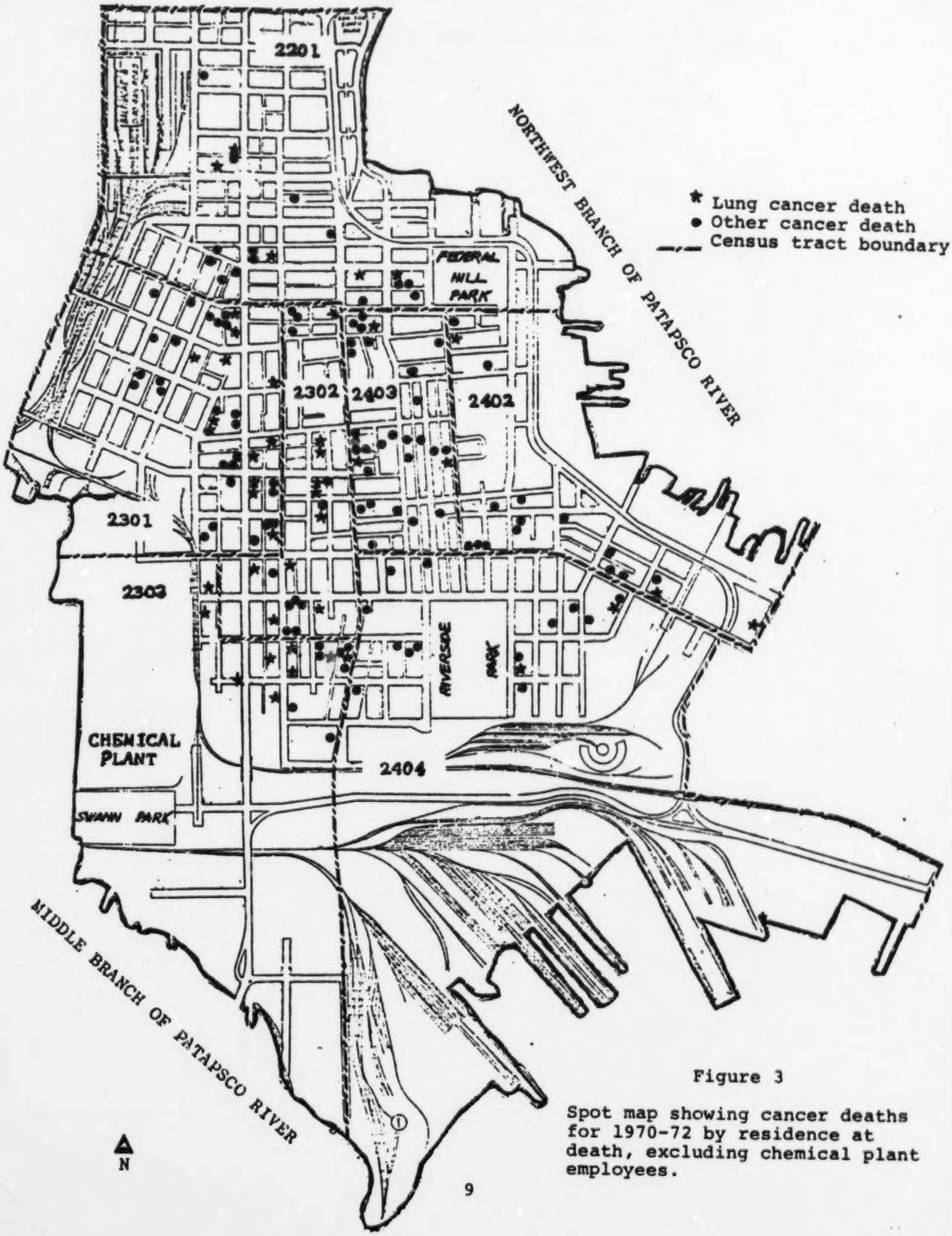


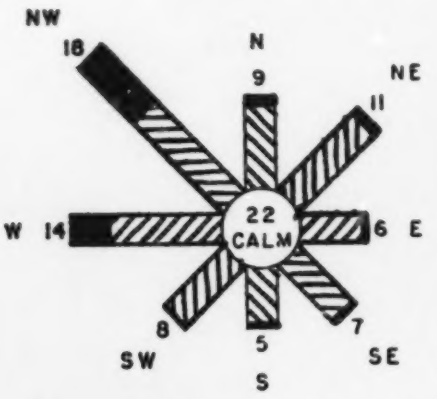
Figure 3

Spot map showing cancer deaths for 1970-72 by residence at death, excluding chemical plant employees.

FIGURE 4

ANNUAL

SUMMER



WINTER

LEGEND

VELOCITIES 4 THRU 15 MPH

VELOCITIES 16 MPH AND OVER

VELOCITIES 0 THRU 3 MPH RECORDED AS CALM.

NUMBERS ARE PER CENT OF TIME WINDS BLEW FROM DIRECTION INDICATED

NOTE: WIND ROSES BASED ON ANALYSIS OF MUNICIPAL AIRPORT WBO HOURLY WIND RECORDS (1933 THRU 1938)

PER CENT OF TIME

5 0 5 10

WIND DATA
BALTIMORE, MD
Date: March 1950 Drawn by: THG

Table 1. Designation of census tracts

	Index Tracts	Adjacent Controls	South Controls	Central Controls	North Controls
Match I	2302	2401	2005	101	1308.02
	2303*	2402	2502.05	104	2804.01
	2404	2403	2503.03	105	2702
			2504.01	601	
			2504.02	602	
			2505	2608	
Match II	2301	2101		703	905
		2201			1203

*Plant located in this tract.

Table 2. Characteristics of index and control census tracts from 1970 census for selected Baltimore areas.

Characteristics	TRACTS										
	Match I							Match II			
	2303	2302	2404	Adjacent Controls	Non-adjacent South Controls	Non-adjacent Central Controls	Non-adjacent North Controls	2301	Adjacent Controls	Non-adjacent Central Controls	Non-adjacent North Controls
Total Population **Range between tracts**	1703	3395	3697	9347 2672-3358	31,174 3143-6893	20,378 2125-4855	12,964 2316-5969	3560	5606 1935-3671	3180	8139 2952-5187
% < 5 yrs	8	8	8	6-8	6-12	6-8	6-10	10	8	10	9
% 5-19 yrs	29	28	28	25-26	24-30	23-28	23-26	30	28-30	30	29-33
% 20-44 yrs	26	28	29	28-29	27-39	26-32	26-35	26	25-26	26	32-34
% 45-64 yrs	28	24	25	23-38	14-28	25-33	22-27	23	25-26	23	17-19
% 65+ yrs	9	11	10	10-16	4-13	12-15	6-17	10	12-13	12	8-10
% male	50	50	48	48-49	47-49	48-50	47-49	49	48-54	48	47-48
% black	-	0.4	-	0-1.9	0.4-2.5	0-1.9	0.1-3.9	50	50-52	47	39-64
Median Income*	8400	9200	8400	8100 to 9300	7500 to 9000	7500 to 9300	8600 to 10000	6500	5800 to 6000	6800	7000 to 7300
% below poverty level	6	9	9	7-8	6-16	7-14	5.7	25	28-29	17	20-22
% head of household 65+ yrs	19	22	19	9-24	9-23	9-38	14-18	11	16-31	20	3-16

*Rounded to nearest hundred dollars.

Table 3. Crude death rates for specific types of cancer for total population in index tracts and matched controls for both Match I and Match II, average rates per 100,000 per year, total deaths for 1970-72, males only.

Type of cancer and 8th revision ISCD code		Match I			Match II		
		Index	Adjacent Controls	Non-adjacent Controls	Index	Adjacent Controls	Non-adjacent Controls
Oral (140-149)	#	2	3	6	1	2	0
	rate	15.46	21.99	6.47	19.11	23.68	-
Stomach (151)	#	1	1	13	0	1	1
	rate	7.73	7.33	14.02	-	11.84	6.20
Colon (153)	#	2	3	15	0	3	4
	rate	15.46	21.99	16.18	-	35.52	24.80
Rectum (154)	#	2	3	7	0	0	0
	rate	15.46	21.99	7.55	-	-	-
Pancreas (157)	#	2	0	10	1	1	0
	rate	15.46	-	10.79	19.11	11.84	-
Lung (162)	#	19	10	97	11	10	12
	rate	146.88[b]	73.31	104.61[b]	210.24[a]	118.41	74.40[a]
Prostate (185)	#	3	3	13	3	3	3
	rate	23.19	21.99	14.02	57.34	35.52	18.60
Bladder (188)	#	0	1	9	0	0	1
	rate	-	7.33	9.71	-	-	6.20
Lymphomas (200-203)	#	1	0	11	1	2	0
	rate	7.73	-	11.86	19.11	23.68	-
Leukemia (204-207)	#	0	0	6	1	0	3
	rate	-	-	6.47	19.11	-	18.60
All cancer (140-209)	#	38	40	241	24	31	40
	rate	293.75[b]	293.23	259.92[b]	458.72[a]	367.08	248.02[a]

a Index significantly different from non-adjacent controls by Woolf-Haldane method (8, 9).
b Index not significantly different from non-adjacent controls.

Table 4. Crude death rates for specific types of cancer for total population in index tracts and matched controls for both Match I and Match II, average rates per 100,000 per year, total deaths for 1970-72, females only.

Type of cancer and 8th revision ISCD code		Match I			Match II		
		Index	Adjacent Controls	Non-adjacent Controls	Index	Adjacent Controls	Non-adjacent Controls
Oral (140-149)	#	2	3	3	0	1	0
	rate	14.87	20.83	2.98	-	11.94	-
Stomach (151)	#	0	3	8	1	1	3
	rate	-	20.83	7.93	18.36	11.94	16.83
Colon (153)	#	1	2	21	1	3	6
	rate	7.44	13.89	20.83	18.36	35.83	33.65
Rectum (154)	#	0	1	8	0	0	1
	rate	-	6.94	7.93	-	-	5.61
Pancreas (157)	#	3	1	14	0	2	2
	rate	22.31	6.94	13.89	-	23.89	11.22
Lung (162)	#	3	1	15	1	3	2
	rate	22.31	27.78	14.88	18.36	35.83	11.22
Breast (174)	#	1	1	27	5	3	6
	rate	7.44	6.94	26.78	91.78	35.83	33.65
Cervix (180)	#	1	2	5	1	4	1
	rate	7.44	13.89	4.96	18.36	47.77	5.61
Bladder (188)	#	0	0	3	0	1	2
	rate	-	-	2.98	-	11.94	11.22
Lymphomas (200-203)	#	0	1	10	0	0	1
	rate	-	6.94	9.92	-	-	5.61
Leukemia (204-207)	#	2	0	5	1	0	0
	rate	14.87	-	4.96	18.36	-	-
All Cancer (140-209)	#	18	28	177	16	23	33
	rate	133.84	194.44	175.55	293.69	274.69	185.09

Table 5. Death rates for selected cancer in white male populations of Match I and white Match II index and control census tracts, rates per 100,000 adjusted for age to 1970 Baltimore City white males.

Type of cancer and 8th revision ISCD code	Baltimore City	Index	Adjacent Controls	South Controls	Central Controls	North Controls
Oral (140-149)	12.06	13.11	22.91	2.53	10.06	9.75
Colon (153)	36.34[a]	18.71	27.85	24.82	13.24	20.21
Pancreas (157)	11.47	13.11	-	14.48	12.71	5.03
Lung (162)	95.62	181.52	90.12	144.07	105.13	103.01
Prostate (185)	24.13	37.38	17.43	23.21	18.29	10.11
Lymphomas (200-203)	20.89[b]	15.89	5.47	16.66	12.53	4.72
Leukemias (204-207)		-	-	8.15	9.87	9.40
All Cancer (140-209)	282.75	608.91	308.76	328.91	301.03	274.55

a This rate includes ISCD codes 153 and 154.
b This rate includes ISCD codes 200-209.

Table 6. Death rates for selected cancers in white female populations of Match I and white Match II index and control census tracts, rates per 100,000 adjusted for age to 1970 Baltimore City white females.

Type of cancer and 8th revision ISCD code	Baltimore City	Index	Adjacent Controls	South Controls	Central Controls	North Controls
Oral (140-149)	4.08	15.60	17.57	5.98	-	5.01
Colon (153)	32.51[a]	8.88	23.57	24.83	28.27	39.25
Pancreas (157)	9.35	26.69	6.00	21.61	23.89	5.01
Lung (162)	18.43	26.77	29.18	11.95	16.27	26.81
Breast (174)	35.67	44.03	18.01	35.40	30.84	47.66
Cervix (180)	7,90	8.88	29.22	7.81	3.28	3.55
Lymphomas (200-203)	16.06[b]	-	6.00	6.89	15.04	14.22
Leukemia (204-207)		6.16	-	11.04	2.72	5.01
All Cancer (140-209)	192.96	144.64	240.28	212.06	212.20	277.08

a This rate includes ISCD codes 153 and 154.
b This rate includes ISCD codes 200-209.

Table 7. Death rates for selected cancers in populations of Match I and whites in Match II index and control census tracts, rates per 100,000 adjusted for age and sex to white 1970 Baltimore City population.

Type of cancer and 8th revision ISCD code	Baltimore City	Index	Adjacent Controls	South Controls	Central Controls	North Controls
Oral (140-149)	7.85	14.42	20.09	4.35	4.75	7.25
Colon (153)	34.32[a]	13.53	25.59	24.82	21.17	30.26
Pancreas (157)	10.35	20.28	3.17	18.24	18.61	5.01
Lung (162)	54.88	99.85	57.96	74.34	58.23	62.79
Lymphomas (200-203)	18.34[b]	7.50	5.75	11.50	13.86	9.73
Leukemia (204-207)		3.25	-	9.68	6.00	7.09
All Cancer (140-209)	235.36	383.87	272.61	267.24	254.15	275.89

a This rate includes ISCD codes 153 and 154.
b This rate includes ISCD codes 200-208.

Table 8. Death rates for selected cancers in black populations of Match II index and control census tracts, rates per 100,000 adjusted for age and sex to black 1970 Baltimore City population.

Type of cancer and 8th revision ISCD code	Baltimore City	Index	Adjacent Controls	Central Controls	North Controls
Oral (140-149)	4.28	9.07	17.21	-	-
Colon (153)	17.77[a]	9.97	17.02	60.11	35.51
Pancreas (157)	8.01	9.07	25.63	-	-
Lung (162)	39.98	79.77	49.26	118.46	35.98
Lymphomas (200-203)	11.03[b]	-	8.59	-	-
Leukemia (204-207)		31.37	-	-	17.56
All Cancer (140-209)	167.93	236.33	215.82	353.44	208.31

a This rate includes ISCD codes 153 and 154.
b This rate includes ISCD codes 200-209.

Table 8. Crude cancer death rates for selected sites in males by individual tract and matched controls, average annual death rate per 100,000.

MATCH I

Cancer Site	2303	Index 2302	2404	Adjacent Controls	South Controls	Central Controls	North Controls
Oral	39.5	19.8	-	22.0	2.2	10.3	10.7
Pancreas	39.5	-	18.6	-	11.1	21.9	29.7
Lung	394.9[a]	138.9[b]	37.3[b]	73.3	109.2	102.8	96.4
Prostate	39.5	19.8	18.6	22.0	15.9	17.1	5.4

MATCH II

Cancer Site	Index WM	2301 BM	Adjacent Controls WM	Adjacent Controls BM	Central Controls WM	Central Controls BM	North Controls WM	North Controls BM
Oral	-	40.1	24.0	23.3	-	-	-	-
Pancreas	-	40.1	-	23.3	-	-	-	-
Lung	146.0[c]	280.6[c]	144.2	93.4	114.8	153.1	56.2	48.2
Prostate	36.5	80.2	-	70.0	-	-	18.8	32.1

a Significant difference compared to each control.
b Not significant compared to each control.
c Lung cancer rates combined for races significantly different from comparable rates of north and adjacent controls.

Table 10. Crude cancer death rates for selected sites in females by individual tract and matched controls, average annual death rate per 100,000.

MATCH I

Cancer Site	2303	Index 2302	2404	Adjacent Controls	South Controls	Central Controls	North Controls
Oral	77.6	-	-	20.8	4.1	-	5.0
Pancreas	-	19.4	34.9	6.9	14.4	21.9	-
Lung	-	58.3	-	27.8	8.2	18.8	24.7
Breast	-	19.4	-	6.9	24.7	31.3	24.7
Cervix	-	19.4	-	13.9	6.2	3.1	5.0

MATCH II

Cancer Site	Index WF	2301 BF	Adjacent Controls WF	Adjacent Controls BF	Central Controls WF	Central Controls BF	North Controls WF	North Controls BF
Oral	-	-	-	22.9	-	-	-	-
Pancreas	-	-	-	45.8	37.7	-	17.4	-
Lung	39.3	-	25.0	45.8	-	43.2	17.4	-
Breast	196.5	-	50.0	22.9	-	-	87.1	14.0
Cervix	-	34.4	75.0	22.9	-	-	-	14.0

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